

Gender Differences in the Psychometric Characteristics of the Inventory of Statements About Self-Injury in A Community Adolescent Sample

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Abstract

Background: The Inventory of Statements About Self-Injury (ISAS) is a psychometrically valid tool to evaluate the motives of non-suicidal self-injury (NSSI), but there is a lack of investigations which could test gender differences in the factor structure of the measurement. However, several differences across gender were identified in self-harm (e.g., in prevalence, methods, functions). Therefore, our study focused on further analyses of the dimensionality of the ISAS functions.

Methods: On a Hungarian adolescent sample (N=1015; 66.1% girl; mean age was 16.81, SD=1.42; 41.2% had a history of NSSI) confirmatory factor analysis and exploratory structural equation modeling frameworks were used to test the factor structure of the ISAS part II.

Results: Results support the two-factor structure of the questionnaire. Intrapersonal and interpersonal motivation factors emerged in the whole sample, but this factor structure varied across gender. Furthermore, among girls, intrapersonal motivation of NSSI associated with higher loneliness, more inflexible emotion regulation, as well as more pronounced level of internalizing and externalizing mental illness symptoms.

Conclusions: Our findings are sufficiently strong arguments to the need of separate examination of NSSI functionality among adolescent girls and boys. It can be assumed that there is a gender difference in the motives underlying in NSSI. In addition, precise scanning of patterns of NSSI functions may further help us to identify the most at-risk adolescents regarding self-harm.

Background

Epidemiology of Non-Suicidal Self-Injury in Adolescence

Non-suicidal self-injury (NSSI) comprises deliberate and conscious acts without intention to die. These behaviors can cause immediate physical damage on the own body tissue including for example cutting, scratching, biting, burning, hitting oneself (International Society for the Study of Self-Injury 2018). These socially unacceptable behaviors are the most common during adolescence (Brown & Plener 2017). According to different surveys, lifetime prevalence of NSSI ranges between 13% and 38% in community adolescent samples (e.g., Brunner et al. 2014; Jacobson & Gould 2007). A systematic review of more than 50 studies concluded that the mean lifetime prevalence of NSSI behaviors was 18% during adolescence (Muehlenkamp, Claes, Havertape, & Plener 2012). However, this review drew attention to that there is a substantial difference in the estimates of lifetime prevalence of self-harm depending on the way of assessment. While single binary item assessment showed a 12.5% average lifetime prevalence, multiple items or behavior checklist method indicated almost twice (23.6%) lifetime prevalence (Muehlenkamp et al. 2012).

Frequency of self-harm is also an important consideration. Although, in adolescent samples, 17-18% international lifetime prevalence were reported for at least one NSSI episode (Swannell, Martin, Page,

Hasking, & John, 2014), significantly fewer young people who engage in self-harm satisfy the cumulative criteria of the non-suicidal self-injury disorder (NSSID) which can be found in the recent edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association, 2013) as a condition for further study. According to the review of Zetterqvist (2015), prevalence of repetitive self-harm in the past year (as defined NSSID) ranged between 1.5 and 6.7% in child and adolescent non-clinical samples.

Furthermore, the Child & Adolescent Self-Harm in Europe (CASE) Study pointed out that nearly 15% of the mainly 15-16 year old adolescents reported self-harm thoughts in the past year, but only 5.8% engaged in self-harm (2.6% engaged in single self-harm episode, while 3.2% engaged in it multiple times) (Madge et al. 2011).

Research have consistently shown that adolescent girls are at greater risk of NSSI than boys, especially in clinical populations (Bresin & Schoenleber, 2015). There is also a gender difference in the most common method of self-harm. While girls mainly engage in self-cutting and carving their skin, boys hit themselves the most likely in a community adolescent sample (Barrocas, Hankin, Young, & Abela, 2012). An other important confounding factor would be intercultural differences in self-harm prevalence (Brunner et al. 2014) and behaviors (Madge et al. 2008).

Moreover, using multiple forms of NSSI are more likely to be linked to more severe intrapersonal and interpersonal problems (Zetterqvist, Lundh, Dahlström, & Svedin 2013), and probably to more dysfunctional emotion regulation.

Motivation for engaging in self-harm

The Four Function Model (FFM; Nock & Prinstein 2004) is one of the most cited functionality model of NSSI. According to the FFM-theory, NSSI acts can serve as intrapersonal ("automatic") together with interpersonal ("social") mechanisms and both processes can reinforce the behavior positively or negatively. In this model, self-harm can (1) decrease negative emotional experiences (automatic negative reinforcement) or (2) generate a (desirable positive) emotional state (automatic positive reinforcement) and can (3) reduce (social negative reinforcement) or (4) induce specific interpersonal experiences (social positive reinforcement). Automatic (intrapersonal) functions are much more common than the social (interpersonal) functions (Brackman & Andover, 2017). In a review, Klonsky (2007) also affirmed that affect-regulation function is the leading motive of engaging in NSSI. Self-punishment was also a common reason for NSSI, but there was less evidence of anti-dissociation, anti-suicide, sensation-seeking, as well as interpersonal-influence and interpersonal boundaries functions of NSSI (Klonsky, 2007).

These results were also confirmed in a meta-analysis, which included 53 independent samples (Taylor, Jomar, Dhingra, Forrester, & Shahmalak 2018). Intrapersonal functions of self-harm were more prevalent (66-81% of participants) than interpersonal motives (32-56% of participants). In particular, the aim of avoidance or escape from an unwanted internal state was the most common intrapersonal function, while

self-punishment and inducing positive feelings via self-harm were the less frequent ones (on average 50% of the participants). Communicating distress was the most frequent interpersonal function, whilst punishing or hurting others was the least frequent (Taylor et al. 2018). However, a systematic review pointed out that social contagion (i.e., influence of the (social) media and friends) has a great impact on the first engagement in NSSI. On the contrary, repeated NSSI mainly influenced by intrapersonal functions (Jarvi, Jackson, Swenson, & Crawford, 2013).

Similarly to some sociodemographic differences in self-harm prevalence and methods, it would be appropriate to examine whether the main motives underlying the self-harm act does not depend on certain characteristics of the participants, such as age, gender, socioeconomic status, clinical or community samples, or even (sub)cultural background. Only a limited number of studies tested the role of gender in self-harm functions. Gender differences were detected in the background of deliberate self-cutting: female adolescents stated twice as high than boys they cut themselves because of they wanted to punish themselves. Similar gender pattern showed in the reason of reducing an unwanted state of mind (Rodham, Hawton, & Evans 2004). However, in a study, which involved 7 countries, were not presented gender and cultural differences in self-harm motives. Researchers only could justify that girls reported more reasons behind self-harm than boys. Furthermore, adolescent girls showed difference according to age: older girls more frequently used self-harm as a cry for help act (Scoliers et al. 2009).

Analysis of NSSI-functions based on the Inventory of Statements About Self-Injury

The second part of the Inventory of Statements About Self-Injury (ISAS Part II; Klonsky & Glenn 2009) measurement has been developed to be capable of assess the underlying causes of NSSI. Already in the initial study, the assessed 13 empirically substantiated motives can be classified into two broader, intrapersonal and interpersonal, functions with exploratory factor analysis (EFA). These two robust factors harmonized with the concept of Nock and Prinstein's (2004) FFM model. The intrapersonal factor comprised 5 subscales: affect-regulation, anti-dissociation, anti-suicide, marking distress, and self-punishment functions of NSSI. While, the interpersonal factor concentrated 8 subscales. Autonomy, interpersonal boundaries, interpersonal influence, peer-bonding, revenge, self-care, sensation seeking, and demonstrating toughness built up the social aspects of NSSI functionality. Only in one of the 13 functionality scales emerged some uncertainty: factor loadings of self-care were marginally different in the case of the interpersonal (.41) and intrapersonal (.33) factors. Furthermore, self-care (when someone engages in self-harm to create a physical wound to care about, instead of experiencing emotional distress) would be a better fit for the intrapersonal factor, conceptually.

The two-factor structure was not affected by gender and ethnicity (Klonsky & Glenn, 2009). Moreover, the two larger factors showed excellent internal consistency and the required associations with clinical phenomena like mood and borderline personality disorder symptoms, as well as suicidality (Klonsky & Glenn 2009). Due to the good reliability and validity of the questionnaire, the ISAS has quickly spread in self-harm studies.

All of the further studies could strengthen the two-factor framework of the ISAS Part II. In 2015, Klonsky and his colleagues affirmed with EFA the intra-, and interpersonal factors in a large clinical sample with a wide age range (from 11 to 73 years old). In keeping with the above, in this analysis, one item (item 17) of the self-care subscale loaded on the intrapersonal factor, while the other two (item 4 and 30) connected clearly to the interpersonal factor (Klonsky, Glenn, Styer, Olino, & Washburn 2015).

Among others, in English-speaking countries (e.g., UK, USA, Canada, Australia) Kortge, Meade and Tennant (2013) also supported the intra-, and interpersonal function factor structure of the ISAS with EFA. Participants over 18 years who joined in online deliberate self-harm peer support groups filled out, *inter alia*, the ISAS. In this research, the self-care subscale clearly loaded into the intrapersonal factor. In this way, the intrapersonal factor comprised 6 subscales (affect-regulation, anti-dissociation, anti-suicide, marking distress, self-punishment, and self-care), while the interpersonal factor brought together 7 subscales (autonomy, interpersonal boundaries, interpersonal influence, peer-bonding, revenge, sensation seeking, and toughness). Based on Rasch analysis, Kortge and her colleagues demonstrated that the most relevant functions for the respondents were interpersonal boundaries and toughness, however, peer bonding was the least relevant in the case of the interpersonal factor. As regards the intrapersonal factor, the strongest endorsed functions were affect-regulation and self-punishment, while the weakest was the motive of self-care. Item functioning was independent from age, nationality, and education level (Kortge et al. 2013).

Similarly, in Turkish (Bildik, Somer, Kabukcu Basay, Basay, & Ozbaran 2013), Korean (Kim, Kim, & Hur 2019), and Spanish (Pérez, García-Alandete, Cañabate, & Marco 2020) samples, the ISAS Part II presented a definitely two-factor structure. Among Turkish high school students Bildik and her colleagues supported the two-dimension model (self-care scale was considered as an interpersonal function) with confirmatory factor analysis (CFA) (Bildik et al. 2013). However, the correlation was particularly high between the implicit factors, suggesting the legitimacy of a general function factor with specific self-harm motives. A recent CFA-analysis on a Spanish clinical sample could confirm the two-factor structure model, where self-care loaded into the intrapersonal factor (Pérez et al. 2020). As a result of the relatively low subsample size of patients with borderline personality disorder, authors could not test invariance according to diagnosis (Pérez et al. 2020). It must be stressed that none of the above mentioned studies analyzed gender or age invariance in the factor structure of the ISAS Part II.

Current study

Based on the review of previous studies on the ISAS, our first aim was to validate the questionnaire and provide NSSI demographics in a Hungarian adolescent sample. On the other hand, we aimed to analyze the factor structure of the ISAS functions (ISAS Part II short version). In this context, our purpose was to further discuss the dimensionality of the ISAS functions in a confirmatory factor analysis (CFA) and exploratory structural equation modeling (ESEM) framework. Beyond the traditional CFA, ESEM analysis can provide a more realistic test of the theoretical constructs and also more accurate estimation of factor intercorrelations. In addition, due to the lack of testing measurement invariance of the ISAS functions

(ISAS Part II) in the previous research, we examined measurement invariance across gender and analyzed gender differences in the factor structure. A further objective of our study was to explore the associations between the functionality factors being found and relevant variables, such as mental health symptoms, emotion regulation aspects, as well as certain features of the self-harm behavior (methods and attitudes related to the self-harm act).

Methods

Participants and Procedure

The cross-sectional study conducted between February 2019 and January 2020 involved 14 secondary schools seated in the capital and rural towns throughout of Hungary. Data were collected from all grades (grades 9–12). Participants completed a questionnaire package in the classroom or computer room under the supervision of trained principal investigators. No teaching staff were present. Based on the technical possibilities of the schools, completion of self-report questionnaires was carried out online on computers or mobile devices using the Qualtrics platform or on paper.

On the whole, 1059 students agreed to cooperate with the study. Of the submitted responses, 44 were excluded from the data analysis due to incompleting filling. Thus, the final sample included 1015 adolescents. All of them were Hungarian. Participants' ages ranged from 14 to 20 years (age $M = 16.81$ years, $SD = 1.42$). Sixty-six percent (66.1%) of the sample were female ($N = 671$), 33.7% were male ($N = 342$), two students (0.2%) failed to respond to this question. Female ($M = 16.84$; $SD = 1.40$) and male ($M = 16.75$; $SD = 1.45$) respondents were similar in age ($t(1005) = 1.05$; $p = 0.295$; $d = 0.06$). Moreover, there was also not a gender difference in the type of residence ($\chi^2(2) = 5.81$; $p = 0.055$; $\phi = 0.08$); girls resided in the capital and countryside nearly the same ratio than boys.

Participation in the study was voluntary and anonymous. All students and one of their parents gave written informed consent to participate in the study. The research plan was approved by the Institution of Review Board of [masked data], and the study was carried out in accordance with the Declaration of Helsinki (WHO, 2001).

Measures

Demographics

Participants provided data on age, gender, type of residence (capital, city, village), school performance, and educational level of parents.

Loneliness

Feelings of loneliness ("Do you feel lonely?") were assessed on a 4-point scale (1 = Never; 2 = Sometimes; 3 = Often; 4 = Very often).

Non-suicidal self-injury

We measured NSSI with the Inventory of Statements about Self-Injury part I and II (Klonsky & Glenn 2009). The first section of the questionnaire detects the lifetime frequency of 12 different self-injurious behaviors performed intentionally and without suicidal intent (e.g., cutting, biting, burning, severe scratching, banging or hitting self, pinching). This part also asks about the main form(s) of self-harm in the respondent's life. Furthermore, five questions associated with other characteristics of NSSI (date of first self-harm act; experienced physical pain during self-harm; was self-injurer alone when he/she performed self-harm and has he/she wanted to stop self-harm; finally, how much time elapses between the urgency and the act of self-harm). The second part of the inventory includes 13 functions of NSSI. In the original version, each function is assessed by three items on a 3-point scale, ranging from 0 to 2 (0 = *Not relevant*, 1 = *Somewhat relevant*, 2 = *Very relevant*). Several studies divided these motives into intrapersonal and interpersonal function categories (e.g., Klonsky & Glenn, 2011; Pérez et al. 2020; Turner 2012). Intrapersonal functions summarize affect regulation, anti-dissociation, antisuicide, marking distress, and self-punishment. Interpersonal functions refer to autonomy, interpersonal boundaries, interpersonal influence, peer-bonding, revenge, self-care, sensation seeking and toughness (Klonsky & Glenn 2011). However, in some studies, self-care rather related to the intrapersonal factor (Kortge, Meade, & Tennant 2013; Pérez et al. 2020). Good reliability coefficients were obtained for both intrapersonal ($\alpha = .80$), and interpersonal factors ($\alpha = .87$) (Glenn & Klonsky 2011). In an unpublished material, Washburn assessed each function by the two most representative items on the same 3-point scale as in the original study. Accordingly, in the short version of the second part of the ISAS, sum scores for each of the 13 functions can range from 0 to 4. We used this short version of the ISAS Part II in our research. Cronbach alphas were similar to the results of Glenn and Klonsky (2011) in our study; $\alpha = .76$ for the intrapersonal, and $\alpha = .82$ for the interpersonal factor.

Mental health screening

Mental health problems, both externalizing and internalizing symptoms, were assessed with the self-report form of the Strength and Difficulties Questionnaire (SDQ, Goodman, Meltzer, & Bailey 1998). The instrument has 25 items allotted into five subscales: Emotional symptoms, Conduct problems, Hyperactivity/inattention, Peer relationship problems, and Prosocial behaviour. A total difficulties score can be computed according to the first 4 factors. Internalizing symptom subscale summarizes Emotional symptoms and Peer relationship problems, while Externalizing symptom subscale integrates Conduct problems and Hyperactivity/inattention items. Participants were asked to score the items on a scale from 0 to 2 (0 = *Not true*, 1 = *Somewhat true*, 2 = *Certainly true*). Higher scores on the first four subscales (symptomatic scales) indicate more severe problems, while on the Prosocial behaviour subscale higher ratings refer to more prosocial activities. In this study, the internal consistency of the total symptoms scale and of the Internalizing symptom subscale as measured by the Cronbach alpha test was adequate ($\alpha = .75$, and $\alpha = .75$), while Externalizing symptom and Prosocial behaviour subscales provided satisfactory internal consistency ($\alpha = .64$, and $.67$, respectively). These internal consistency scores

compare well with the original questionnaire (Goodman et al. 1998). In our analyses we only used the total symptom, the Internalizing and Externalizing symptom and the Prosocial behaviour subscales.

Emotion regulation

Self-critical rumination

Self-critical perseverative style of thinking was assessed by the 10-item Self-Critical Rumination Scale (SCRS; Smart, Peters, & Baer 2015). Items should be rated on a 4-point scale (from 1 = *Not at all* to 4 = *Very much*). The single-factor structure questionnaire showed excellent internal consistency in the original study ($\alpha = .92$; Smart, Peters, & Baer 2015), as well as in our research ($\alpha = .91$).

Experiential avoidance

Avoidance and Fusion Questionnaire for Youth (AFQ-Y8; Greco, Lambert, & Baer 2008) is an 8-item scale which measures tendencies of experiential avoidance and cognitive fusion as markers of psychological inflexibility. Items are rated on a 5-point scale from 0 = *Not at all true* to 4 = *Very true*. The factor structure of the AFQ-Y8 reflects one factor, with higher scores showing stronger experiential avoidance. The scale had good internal consistency in the initial study ($\alpha = .83$ in Greco et al. 2008), while in this study Cronbach alpha was acceptable ($\alpha = .70$).

Data Analysis

In order to understand the factor structure of motives of self-harm, we parcelled two items of each motives resulting in 13 observed indicator variables scored from 0 to 4. We used these observed variables as ordinal indicators. We used both the more restrictive CFA approach which fixes all cross loadings in zero, and more flexible exploratory structural equation modeling (ESEM) which allows cross-loadings which may represent the complexity of measurement models. Furthermore, the flexible ESEM approach also allows to use the statistical advances of structural equation modeling including goodness of fit statistics; inclusion of correlated uniquenesses; multiple indicators multiple causes models (MIMIC models); and tests of multiple group invariance (Morin et al. 2013). Confirmatory factor analyses and exploratory structural equation modeling (ESEM) were performed with Mplus 8.0 (Muthén & Muthén 1998–2017). Weighted Least Squares Mean and Variance adjusted (WLSMV) estimation method was used (Brown 2015; Finney & DiStefano 2006). The analyses were based on WLSMV estimation which utilizes the entire weight matrix to compute S.E. for the parameters, but this method avoids the matrix inversion (Finney & DiStefano 2006). Missing values were treated with full maximum likelihood function implemented in Mplus.

The first step was to test a one-factor model. The second step was to test a two-factor model described in the work of Klonsky and Glenn (2009). We also tested the two-factor ESEM model with target rotation which allows the cross-loadings. Although we also planned to investigate the measurement invariance across gender, the inspection of factor loadings revealed large differences across gender, therefore we did not continue the formal tests of measurement invariance.

The next step, we also investigated the multiple indicators multiple causes (MIMIC) models to estimate the effects of covariates such as experiential avoidance, self-critical rumination, and loneliness. Furthermore, we also estimated the effects of internalizing and externalizing symptoms, and prosocial behavior on self-harm motives. We estimated the two sets of covariates separately because of the medium and large correlations among covariates may cause multicollinearity problems in the model.

As the final step, factor scores were calculated for further analyses including multinomial logistic regression analysis to predict the type of self-harms reported.

In the CFA and ESEM analyses, the satisfactory degree of fit requires the comparative fit index (CFI) to be larger than 0.95, the Tucker-Lewis Index (TLI) to be close to or larger than 0.95. The third fit index applied in this study was root mean square error approximation (RMSEA). RMSEA below 0.05 indicates excellent fit, the value around 0.08 indicates adequate fit, and the value above 0.10 specifies poor fit.

Results

Descriptive statistics of self-harm behaviors

In the present sample, 58.8 % (N=597) of the adolescents had never engaged in self-harm, while 41.2% (N=418) had a history of NSSI, of which 76.8% (N=321, 31.6% of the whole sample) reported current self-harm behavior within the past month. Most of the current self-harmers (88.5%; N=284) engaged in self-harm from 1 to 5 days in the past month, while 3.7% (N=12) between 6 and 10 days, 2.2% (N=7) between 11 and 15 days, while 5.6% (N=18) more than 15 days.

Gender difference was pointed out in the lifetime prevalence of self-harm ($\chi^2(1)=6.43$; $p=0.011$; $\phi=0.08$). Significantly higher rates of adolescent girls tend to engage in self-harm (44.0%; N=295) than boys (35.7%; N=122), however the effect size was small. At the same time, no gender difference was shown in the current (past month) prevalence of self-harm ($\chi^2(3)=0.66$; $p=0.882$; $\phi=0.05$).

Among those who engaged in self-harm, the most common types of self-harm behavior were banging or hitting self (53.1%; N=222) and interfering with wound healing (52.2%; N=218). Cutting (40.7%; N=170), biting (39%; N=163), pinching (38.8%; N=162), and severe scratching (34.4%; N=144) were also relatively frequent. Swallowing dangerous substances was the less prevalent method for self-harm (7.2%; N=30). The frequencies of different types of self-harm behavior according to occasional (<10) and recurrent (≥ 10 lifetime episodes) self-harm are presented in Table 1. Compared to boys, girls reported significantly higher frequencies of using four types of self-harm such as cutting ($\chi^2=18.7$, $p<.001$), carving ($\chi^2=8.3$, $p<.02$), severe scratching ($\chi^2=18.0$, $p<.001$), and banging or hitting self ($\chi^2=6.4$, $p<.040$).

Average age when respondents engaged in self-harm at first time was 11.97 years (SD=3.55), with the highest prevalence between the ages of twelve and fifteen. Almost one third of the self-harmers (31.3%; N=131) had a history of recurrent NSSI (≥ 10 lifetime episodes; based on Gratz, Dixon-Gordon, Chapman, & Tull, 2015), while 68.7% (N=287) could be described as occasional self-harmers (<10 lifetime episodes

of any type(s) of NSSI). Self-harmers applied 3.94 self-harm methods on average (SD=2.59; range between 1-11 methods). No gender difference was found in the frequency (repetitive vs. occasional) of the self-harm episodes ($\chi^2(1)=2.15$; $p=0.14$; $\phi=0.07$), as well as in versatility of NSSI (i.e., number of self-harm methods; $\chi^2(10)=17.35$; $p=0.067$; $\phi=0.21$), however the effect size was large in the latter case.

Thirty-three percent (33.8%; $N=129$) of the self-harmers experienced pain during the act, 41.1% ($N=157$) sometimes experienced pain, while 25.1% ($N=96$) reported no pain. The majority of those who engaged in self-harm was alone during the act (62.2%; $N=237$), 22.8% ($N=87$) indicated they were sometimes alone, while 15% ($N=57$) were not alone at that time. Forty-two percent (42.2%; $N=154$) of self-harmers engaged in NSSI in less than an hour when they experienced the urge to self-harm, while 44.4% ($N=162$) were able to wait more than a day. Most of the self-harmers would like to break off engaging in NSSI (82.3%; $N=302$), however, 17.7% ($N=65$) had never wanted to stop self-harm behaviors.

Table 1 *Frequencies of non-suicidal self-injury among self-harmers*

	Less than 10 times	10 times or more
Types of self-harm	n (%)	n (%)
Cutting	98 (23.6)	72 (17.3)
Biting	76 (18.2)	87 (20.8)
Burning	51 (12.3)	27 (6.5)
Carving	82 (19.7)	34 (8.2)
Pinching	66 (15.8)	96 (23.0)
Pulling hair	37 (8.9)	41 (9.8)
Severe scratching	56 (13.4)	88 (21.2)
Banging or hitting self	87 (20.8)	135 (32.4)
Interfering with wound healing	60 (14.5)	158 (38.1)
Rubbing skin against rough surface	34 (8.2)	39 (9.4)
Sticking self with needles	49 (11.7)	57 (13.6)
Swallowing dangerous substances	23 (5.5)	7 (1.7)
Other	9 (2.2)	21 (5.0)

Note. $N=414-417$.

Dimensionality of self-harm motives

We performed several CFAs to test several alternative models of self-harm motives. The fit indices of tested models are reported in Table 2. First, we tested the one-factor model which yielded unacceptable degree of fit. We also tested the two-factor model based on previous study reported in Klonsky and Glenn (2009), this model also yielded unacceptable degree of fit. As the next step, we performed two-factor exploratory structural equation modeling (ESEM) analysis, in which we allowed cross-loadings. This model yielded acceptable degree of fit. After the inspection of modification indices, we allowed the error correlation between toughness and sensation seeking, which increased the degree of fit, therefore, in the further analyses we used this measurement model. Factor loadings of this model are presented in Table 3. In the total sample, we observed large cross-loadings of marking distress, interpersonal boundaries, toughness and autonomy.

Table 2 *Fit indices of alternative measurement models*

	χ^2	df	CFI	TLI	RMSEA [90%CI]
One-factor model	621.5	65	0.689	0.627	0.157 [0.146-0.168]
Two-factor model (Klonsky & Glenn, 2009)	489.9	64	0.762	0.710	0.138 [0.127-0.150]
Two-factor ESEM model (Klonsky & Glenn, 2009)	175.2	53	0.932	0.900	0.081 [0.068-0.095]
Two-factor ESEM model (Klonsky & Glenn, 2009) with modification*	134.3	52	0.954	0.931	0.067 [0.053-0.081]
Gender difference					
Boys	89.1	52	0.960	0.940	0.086 [0.054-0.116]
Girls	102.2	52	0.954	0.931	0.062 [0.044-0.080]

Note.:* Error correlation is allowed between Toughness and Sensation seeking. $N=349$.

In the further analysis, we performed the CFA in boys and girls separately. Inspecting the factor loadings implied that different factor structure might be present in both gender. However, due to the small sample

size of boys we did not investigate this difference further, and restricted our analyses to the girls' sample.

In the girls' sample, the original two-factor model was supported with intrapersonal and interpersonal motive factors. The variables with the highest loadings on intrapersonal factors were affect-regulation, self-punishment and anti-dissociation, and importantly these variables did not have salient loadings on the interpersonal factor. The variables with the highest loadings on interpersonal factors and negligible cross loadings on the other factor were peer bonding, interpersonal influence, self-care, anti-suicide and revenge. Several items loaded saliently on both factors such as marking distress, interpersonal boundaries, sensation seeking, toughness and autonomy. These motives may have both intra- and interpersonal components.

Table 3 *Factor loadings from exploratory structural equation modeling*

	Total		Boys		Girls	
	Intra-personal	Inter-personal	Intra-personal	Inter-personal	Intra-personal	Inter-personal
Affect regulation	0.781	0.134	-0.096	0.566	0.810	0.158
Self-punishment	0.753	0.157	0.021	0.611	0.770	0.155
Anti-dissociation	0.806	0.247	-0.065	0.739	0.833	0.244
Anti-suicide	0.029	0.540	0.584	0.504	-0.001	0.528
Marking distress	0.686	0.517	0.161	0.904	0.692	0.494
Interpersonal boundaries	0.524	0.525	0.335	0.699	0.582	0.529
Self-care	0.127	0.732	0.670	0.720	0.128	0.694
Sensation seeking	0.272	0.484	0.371	0.697	0.325	0.380
Peer bonding	-0.178	0.772	0.998	0.570	-0.195	0.707
Interpersonal influence	0.153	0.700	0.518	0.740	0.109	0.705
Toughness	0.406	0.452	-0.116	0.532	0.441	0.545
Autonomy	0.300	0.784	0.492	0.743	0.333	0.821
Revenge	0.242	0.704	0.665	0.787	0.295	0.613
Factor correlations	-0.25		-0.34		-0.33	

Note. Rotation is target. Salient loadings (> 0.30) are boldfaced. $N=348$. $N_{boys}=96$. $N_{girls}=252$.

Construct validity of self-harm motives: Concurrent predictive validity of self-harm motives

We tested whether self-harm motives are associated with any types of self-harm among girls. For the multinomial regression analysis we recoded the lifetime frequencies of using each type of self-harm into three categories: no use as a reference category, low frequency of use (less than 10 times) and high frequency of use (10 or more times of use). The motives were used as explanatory variables and age was controlled in all regression models (Table 4).

High frequency of use was predicted only by the intrapersonal motive factor with the exception of interfering with wound healing, however the odds ratios varied from 8.37 (cutting) to 1.98 (rubbing skin against rough surface). Low frequency of use of each type of self-harm was also predicted by intrapersonal motive factor with exception of carving, pinching, banging or hitting self, interfering with wound healing, and sticking self with needles. The interpersonal motive factor predicted only the low frequency of rubbing skin against rough surface (Table 4).

Table 4 *Concurrent predictive validity of self-harm motives: Multinomial regression analyses among girls*

	Less than 10 times		10 times or more		
Type of self-harm	Intrapersonal motives [#]	Interpersonal motives [#]	Intrapersonal motives [#]	Interpersonal motives [#]	R ²
Cutting	2.01 [1.32-3.06]***	1.40 [0.97-2.02]	8.37 [4.54-15.44]***	1.51 [0.91-2.50]	30.5%
Biting	1.83 [1.21-2.76]**	1.02 [0.67-1.54]	3.01 [1.89-4.79]***	1.47 [0.94-2.32]	13.2%
Burning	2.11 [1.29-3.44]**	1.02 [0.62-1.68]	3.99 [1.96-8.11]***	1.45 [0.74-2.84]	13.2%
Carving	1.29 [0.88-1.90]	1.34 [0.92-1.95]	2.88 [1.62-5.11]***	1.15 [0.64-2.06]	9.9%
Pinching	1.18 [0.76-1.83]	0.87 [0.56-1.35]	1.99 [1.35-2.93]***	0.82 [0.54-1.23]	10.1%
Pulling hair	1.96 [1.13-3.29]*	0.87 [0.49-1.54]	2.59 [1.47-4.58]**	0.81 [0.44-1.48]	10.7%
Severe scratching	2.45 [1.50-4.00]***	1.14 [0.72-1.80]	3.35 [2.18-5.16]***	1.07 [0.71-1.60]	20.3%
Banging or hitting self	1.38 [0.92-2.06]	0.82 [0.55-1.23]	2.33 [1.58-3.44]***	1.22 [0.83-1.79]	10.0%
Interfering with wound healing	0.86 [0.55-1.35]	0.81 [0.51-1.29]	1.14 [0.82-1.60]	1.19 [0.84-1.69]	6.3%
Rubbing skin against rough surface	3.55 [1.81-6.97]***	2.40 [1.27-4.56]**	1.98 [1.17-3.36]*	1.23 [0.72-2.12]	13.4%
Sticking self with needles	1.31 [0.83-2.05]	0.94 [0.59-1.51]	2.01 [1.26-3.21]**	0.90 [0.59-1.59]	5.7%
Swallowing dangerous substances	4.79 [2.00-11.49]***	1.07 [0.44-2.60]	5.65 [1.23-26.01]*	3.21 [0.74-13.90]	21.9%

Note. Odds ratio [95% Confidence interval]. [#]: Factor scores. Age was controlled. R² is Nagelkerke R². Boldfaced values are significant at least at p < 0.05. Reference group is 0 (none). N=251.

Explanatory variables of self-harm motives: Multiple indicators-multiple causes

We also tested in one model if experiential avoidance and self-critical rumination as transdiagnostic symptoms explain any variance of self-harm motives among girls. We also included here loneliness and age. Standardized regression coefficients are presented in Table 5. Loneliness, experiential avoidance and self-critical rumination predicted intrapersonal motives significantly. So higher loneliness, higher experiential avoidance and stronger self-critical rumination are associated with higher intrapersonal motives. The interpersonal motive factor was explained by age and loneliness. Younger age and lower loneliness are associated with stronger interpersonal motive. We tested in another model whether internalizing and externalizing symptoms, and prosocial behavior are linked with self-harm motives. Both internalizing and externalizing symptoms were linked with intrapersonal motives. So higher internalizing and externalizing symptoms associated with higher intrapersonal motives however, the link seems to be stronger in case of internalizing symptoms. Internalizing symptoms and age, on the other hand, negatively associated with interpersonal motives, thus higher score on internalizing symptoms and older age is associated with lower interpersonal motives. Correlations for the variables are summarized in Supplementary Table 1.

Table 5 *Explanatory variables of self-harm motives among girls*

	Intrapersonal motives	Interpersonal motives
Model 1		
Age	0.11	-0.16*
Loneliness#	-0.27***	0.22*
Experiential avoidance (AFQ-Y8)	0.24**	0.03
Self-critical rumination (SCRS)	0.20*	-0.11
R^2	36.6%	10.2%
Model 2		
Internalizing symptoms (SDQ)	0.40***	-0.20**
Externalizing symptoms (SDQ)	0.15*	0.14
Prosocial behavior (SDQ)	0.03	0.05
Age	0.09	-0.17*
R^2	21.6%	7.6%

Note. #: Reversed item. AFQ-Y8=Avoidance and Fusion Questionnaire for Youth. SCRS=Self-Critical Rumination Scale. SDQ=Strength and Difficulties Questionnaire. $N=251$.

Discussion

Several current studies reported growing incidence of NSSI in nonclinical adolescent populations (Brunner et al. 2014; Cipriano, Cella, & Cotrufo 2017). However, only a few valid, reliable, and complex NSSI measurements exist. Furthermore, testing of psychometric properties of existing questionnaires is also scarce. Our aim was therefore twofold: firstly, to present extensive self-harm demographics in a large Hungarian adolescent sample, and secondly, to further test the factor structure of the Inventory of Statements About Self-Injury part II (Klonsky & Glenn 2009) taking into account of possible gender differences. To the best of our knowledge, this is the first research which used ESEM approach in testing the functionality factors of the ISAS part II. One of the main advantages of applying ESEM analysis was that target rotation could decrease the possible high correlation among the two self-harm factors (Bildik et al. 2013). Furthermore, the use of ESEM is also justified because some ISAS function items (e.g., self-care; Klonsky & Glenn 2009) could similarly load into both the intra-, and interpersonal factors. Thus, a more realistic picture might emerge of the factor structure.

In our sample, 41% of the secondary school pupils had already engaged in some form of non-suicidal self-injury. This relatively high lifetime prevalence rate is parallel to the ceilings of self-harm measurements in community adolescent samples (Brunner et al. 2014; Cipriano, Cella, & Cotrufo 2017). In this respect, it should be recalled that two-thirds of self-harmers engaged in any NSSI acts less than 10 times in their life. This group could be described as occasional self-harmers (Gratz et al., 2015). Future research should clarify precisely the possible differences between occasional and repetitive self-harmers in NSSI functions and other related variables (e.g., mental health aspects, emotion regulation, psychosocial functioning).

Nearly one third of our nonclinical adolescent sample reported current self-harm. It is worth to noting that the majority of current self-harmers engaged in self-harm from 1 to 5 occasions in the previous month. Only 3.6% of the total sample indicated more frequent NSSI in the past month. This subgroup is particularly vulnerable regarding repetitive self-harm. These results are also consistent with former studies which revealed NSSI prevalence between 1.5 and 6.7% in non-clinical adolescent samples (Zetterqvist 2015). Such findings demonstrate the need to introduce effective and multiple behavior checklist methods into secondary prevention of NSSI among youth. The ISAS could be a low cost but comprehensive tool in order to screen the frequency, forms and motives of self-harm in school environments, in line with this, to prevent further NSSI-associated physical and psychological health issues (e.g., functional impairment; Veague, Collins, & Levitt 2008). On this point, another crucial aspect is the age of target population. Similar to previous studies (Glenn & Klonsky 2009; Kostić, Žikić, Stankovic, & Nikolić 2019), onset of self-harm can be date back typically between the ages of 12 and 15 in our sample. The fact that the first NSSI episode happened on average at the age of 12 points out the importance of self-harm prevention awareness in lower secondary schools.

More than half of those who engaged in self-harm used hitting and/or interfering with wound healing. Cutting, biting, pinching and severe scratching were also common. Swallowing dangerous substances

was the least frequent method, which could be linked to its invasive and more drastic nature. Moreover, swallowing poisonous substances is stronger associated with suicide attempts than non-suicidal self-injury. According to the World Health Organization, self-poisoning with pesticide accounts for 20% of suicide worldwide (WHO 2019).

Completely in line with former studies (Bresin & Schoenleber, 2015), adolescent girls reported higher lifetime prevalence of NSSI in our survey. However, it is important to underline that there was no gender difference in the NSSI prevalence of the previous month, and furthermore in two indicators of severity (frequency and versatility) of NSSI. It would be worth analyzing in further studies the possible background of these results at different age levels in adolescence. In our sample, girls engaged in cutting, carving, severe scratching and hitting self in greater proportion than boys. These results are partly similar with former studies among nonclinical adolescents, where different forms of scraping the skin were more common among girls (Barrocas et al. 2012). However, in most of former surveys among adolescents, hitting self was more typically related to boys (Barrocas et al. 2012), but in a meta-analysis which included adult populations gender difference was not found in the prevalence of hitting.

Regarding the factor structure of the ISAS part II, our results based on ESEM analysis could strengthen the two-factor structure of self-harm motives. In addition, the two function factors are clear to interpret. These results are very similar to previous findings (Klonsky & Glenn 2009; Bildik et al. 2013; Kortge et al. 2013; Klonsky et al. 2015; Kim et al. 2019; Pérez et al. 2020). In our analysis, affect regulation, self-punishment and anti-dissociation functions purely loaded onto the first factor which can be described as an intrapersonal motive factor. However, anti-suicide function, which traditionally belongs to intrapersonal motives, loaded strongly on the interpersonal factor. Therefore, in this study, the second factor which can be described as an interpersonal motive factor is made up self-care, sensation seeking, peer-bonding, interpersonal influence, revenge, autonomy, and anti-suicide self-harm motives. It is a fascinating question how anti-suicide function of NSSI could be related to interpersonal processes. A conceivable explanation would be that in adolescence suicidal thoughts are often linked with imagined reactions of family and friends to a possible fatal outcome. Moreover, it is also common that young people are concerned about the impact of their possible death on their immediate environment. In this context, adolescents easily attribute relational and communicative value to suicidal thoughts or behaviors, or, on the contrary, to avoid the impulse to attempt suicide, even with self-harm.

Our results can strengthen former analyses which identified self-care rather as an interpersonal NSSI motive (e.g., Klonsky & Glenn 2009; Bildik et al. 2013). Nonetheless, marking distress, interpersonal boundaries and demonstrating toughness motives may have both intra- and interpersonal components, whereas these possible functions of NSSI loaded on both factors nearly the same strength. Furthermore, these motives showed large cross loadings. Each of these three functions may be interpreted as processes which can regulate the boundaries between the self and not-self. Therefore, the question arises whether certain motives of self-harm could reflect to difficulties in distinguishing the internal (self) and external boundaries (reality, relationships). Separating flexibly the self from others is a main developmental task in adolescence. Becoming more autonomous, working out individual identity in a

complex way, as well as managing relationships can increase uncertainty (Erikson 1963). In further studies, it would be interesting to find out about the possible links between certain NSSI functions and self concept of adolescents, as well as emotional maturity.

The most relevant functions of the intrapersonal factor were anti-dissociation and affect-regulation. This is parallel with former results which identified affect regulation as a leading motive in self-harm (Klonsky 2007). Whilst, for the interpersonal factor autonomy and peer-bonding were the most relevant functions. These results can be integrated well into the FFM Model (Nock & Prinstein 2004). Intrapersonal aspects of NSSI can help managing intolerable emotional experiences (automatic reinforcement), while interpersonal facets can assist in attaching to and/or detaching from others (social reinforcement). Contrary to what Kortge and her colleagues (2013) found, peer bonding was a strongly endorsed motive of interpersonal factor. This can be explained by the results in the recent decade, which pointed out a significant peer socialization effect of friends mainly on younger adolescents' self-harm behavior (Prinstein et al. 2010). This process can be linked to the effects of social media. A systematic review concluded that online social networking can lead to increasing involvement of self-harm behavior as young people share their thoughts and practices about NSSI with each other or seek social support from their companions through social media platforms (Memon, Sharma, Mohite, & Jain 2018).

Contrary to the Turkish results (Bildik et al. 2013), in our study, the intrapersonal and interpersonal factors correlated weakly giving a further indication of their partition.

We found that the factor structure of the ISAS part II can be different between gender. Therefore, we could not analyze the configural, metric, and scalar invariance for the best fitting model in a multiple group analysis between boys and girls. Among girls the factor structure was identical with the analysis in the whole sample. At the same time, among boys all of the self-harm motives loaded onto the interpersonal factor with the addition that eight motives have simultaneous loadings on both the inter- and intrapersonal factors. Furthermore, marking distress function had a salient loading on the interpersonal factor among male adolescents. These results reflect the possibility that boys interpreted the use of self-harm acts as a cry for help communication addressed to their environment. In addition, due to the small sample size of adolescent boys we keep on further, validity and explanatory, analysis only among girls.

Among adolescent girls, we could provide evidence for concurrent predictive validity of self-harm functions. The intrapersonal motive factor explained higher frequency (10 or more times) of use of almost all the self-harm methods (except interfering with wound healing). Cutting, swallowing dangerous substances, and burning were predicted the strongest by intrapersonal motives of self-harm. Our results are completely consistent with former studies which demonstrated that intrapersonal functions are much more frequently lie behind NSSI than interpersonal functions (Brackman & Andover 2017). Coping with negative emotions, self-punishment, and reducing dissociation as motivations can be liable to increase the frequency of NSSI. In particular, the frequent use of the most frequent NSSI method among women and in clinical samples (i.e., cutting; Klonsky & Muehlenkamp 2007) relates the most to affect-regulation.

Furthermore, we were able to demonstrate among girls that possible transdiagnostic factors such as self-critical rumination and experiential avoidance (Im & Kahler, 2020), as well as loneliness explained more than one third of the variance in intrapersonal functionality. Higher use of specific inflexible emotion regulation strategies and loneliness have a great impact on the emergence of intrapersonal motivations for engaging in self-harm. Additionally, higher level of internalizing and externalizing mental illness symptoms predicted higher intrapersonal motives regarding self-harm. These results can be easily incorporated into the Experiential Avoidance Model (EAM; Chapman, Gratz, & Brown 2006). Deficiencies in emotion regulation, therefore poorer distress tolerance and mental health status, may generate intense emotions which could activate self-harm acts to avoid overwhelming aversive affects (Chapman et al. 2006).

With regard to interpersonal functionality, the pattern is the inverse in certain respects. In conclusion, lower loneliness, lower internalizing symptoms, and younger age are associated with higher interpersonal motivation for self-harm, however, the explained variance is relatively low. These results bring to our notice that younger adolescents with fewer mood and anxiety symptoms, but with wider social circle could be more responsive and vulnerable to engaging in self-harm because of interpersonal than intrapersonal reasons. Further research will be able to respond how peers may impact on these processes.

Limitations

Our study examined a generally healthy population. Although we surveyed mental health symptoms (that is, internalizing and externalizing symptoms), but for ethical reasons we did not ask specific questions about former or present psychological disorders, as well as pharmacotherapy or psychological treatment. Furthermore, self-report psychiatric history is more unreliable and we had no opportunity to conduct clinical diagnostic interviews. Therefore, it is possible that our sample contains participants suffered/suffering in different types of mental illness syndromes which may have influenced our results. However, assessing and built internalizing and externalizing symptoms in our models we could take into account these variables such as subclinical level of mental health problems.

A main limitation was the relatively low sample size of male adolescents. In further studies, it would be important to increase and equalize the proportion of male participants, in particular, because of the somewhat contradictory results about gender differences in pure NSSI groups (Whitlock et al. 2015).

Another limitation of our research is the cross-sectional study design, therefore, we could not provide causal relationships in the explanatory analyses. Furthermore, the study was based on self-report measures filled in classrooms. Even though, trained investigators supervised and helped the process of collective testings and no teaching staff were present in the classes, there was a risk of less than honest responses because of the sensitive topic and social desirability.

Conclusion

Based on ESEM approach, this study can contribute to the factor structure analyses of the ISAS part II. Beside confirmation of the two-factor structure (i.e., intra- and interpersonal factors) of the questionnaire, we also pointed out that this structure varies across gender. In the girls' sample, we detected robust associations between intrapersonal functionality of NSSI and poorer mental health and emotion regulation aspects, as well as more frequent self-harm.

List Of Abbreviations

AFQ-Y8

Avoidance and Fusion Questionnaire for Youth

CASE

Child & Adolescent Self-Harm in Europe Study

CFA

confirmatory factor analyses

CFI

Comparative Fit Index

EAM

Experiential Avoidance Model

EFA

exploratory factor analysis

ESEM

exploratory structural equation modeling

FFM

Four Function Model

ISAS

Inventory of Statements About Self-Injury

MIMIC

Multiple Indicator Multiple Causes

NSSI

non-suicidal self-injury

NSSID

non-suicidal self-injury disorder

RMSEA

Root Mean Squared Error of Approximation

SCRS

Self-Critical Rumination Scale

SDQ

Strength and Difficulties Questionnaire

TLI

Tucker-Lewis Index

WHO
World Health Organization
WLSMV
Weighted Least Squares Mean and Variance

Declarations

Ethics approval

All of the authors declare that they have complied with the ethical standards of the APA in the treatment of their sample.

The study was ethically approved by the ELTE Eötvös Loránd University Faculty of Education and Psychology Research Ethics Committee (Reference number: 2018/431; Date of issue: 20th of December 2018) and the work was conducted in accordance with the Declaration of Helsinki.

Consent to participate

Participation in the study was voluntary and anonymous. Written informed consent was sought from all of the respondents and one of their parents.

Consent for publication

Not applicable.

Availability of data and materials

The dataset used and analysed during the current study is available from the corresponding author on reasonable request.

Competing interests

The authors (*Melinda Reinhardt, Gyöngyi Kökönyei, Boglárka Drubina, Róbert Urbán*) declare that they have no competing interests: they do not have any interests that could constitute a real, potential or apparent conflict of interest with respect to their involvement in the publication. The authors also declare that they do not have any financial or other relations (e.g., directorship, consultancy or speaker fee) with companies, trade associations, unions or groups (including civic associations and public interest groups) that may gain or lose financially from the results or conclusions in the study.

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Authors' contributions

Melinda Reinhardt and Gyöngyi Kökönyei developed the research concept and study design. Data collection were performed by Melinda Reinhardt and Boglárka Drubina. Data analysis were accomplished by Róbert Urbán and Melinda Reinhardt. Melinda Reinhardt drafted the manuscript and Róbert Urbán, Gyöngyi Kökönyei, and Boglárka Drubina provided critical revisions. All of the authors approved the final manuscript for submission. The corresponding author affirms that she has listed everyone who contributed significantly to the whole work.

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